

General Chemistry

- 1.(a) State the first law of thermodynamics. (b) What is meant by the internal energy of a system? (c) By what means can the internal energy of a system increase? (9 分)
- 2.(a) Write the chemical formula for aluminum oxide. (b) Would you expect this substance to be a solid, liquid, or gas at room temperature? (c) Write the balanced chemical equation for the reaction of aluminum oxide with nitric acid. (9 分)
- 3.(a) What is meant by the term polarizability? (b) Which of the the following atoms would you expect to be most polarizable: O, S, Se, or Te? Explain.(c)Put the following molecules in order of increasing polarizability: GeCl_4 , CH_4 , SiCl_4 , SiH_4 , GeBr_4 . (12 分)
- 4.Ceramics are generally brittle, subject to crack failure, and stable to high temperatures. In contrast, plastics are generally deformable under stress and have limited thermal stability. Discuss these differences in terms of the structures and bonding in the two classes of materials. (8 分)
- 5.(a)For a process that occurs at constant temperature, express the change in Gibbs free energy in terms of changes in the enthalpy and entropy of the system. (b)For a certain process that occurs at constant T and P, the value of ΔG is positive. What can you conclude? (c)What is the relationship between ΔG for a process and the rate at which it occurs? (12 分)

General Physics

6. Three charges are fixed in the x-y plane as shown in Fig 1: $q_1 = -3\mu\text{C}$, and $q_2 = 3\mu\text{C}$ along the x-axis at $(-2\text{m}, 0)$ and $(+2\text{m}, 0)$ respectively and $q_3 = -6\mu\text{C}$ along the y-axis at $(0, -2\text{m})$. Please compute (1) the magnitude of the electric field E at the origin; (2) the electric potential V at the origin. Define the zero of potential to be infinitely far from the three charges. (3) Suppose an electron ($q = -1.6 \times 10^{-19} \text{C}$, $m = 9.1 \times 10^{-31} \text{kg}$) is released from rest at the origin. At what angle will the electron move? (4) What will be the terminal velocity of the electron, i.e. at what speed will the electron be moving when it is far from the origin? (5) What is the potential energy U of the three charges shown in the picture? (10 points for each question)